

RESOURCE PROSPECTOR LANDING SITE AND TRAVERSE PLAN DEVELOPMENT. R. C. Elphic¹, A. Colaprete¹, M. Shirley¹, A. McGovern², R. Beyer³, ¹NASA Ames Research Center, Moffett Field, CA 94035 USA; ²Johns Hopkins Applied Physics Laboratory, Laurel, MD 20723 USA; ³SETI/NASA Ames Research Center, Moffett Field, CA 94035 USA.

Introduction: Resource Prospector (RP) will be the first lunar surface robotic expedition to explore the character and feasibility of in situ resource utilization at the lunar poles. It is aimed at determining where, and how much, hydrogen-bearing and other volatiles are sequestered in polar cold traps. To meet its goals, the mission should land where the likelihood of finding polar volatiles is high [1,2,3]. The operational environment is challenging: very low sun elevations, long shadows cast by even moderate relief, cryogenic sub-surface temperatures, unknown regolith properties, and very dynamic sun and Earth communications geometries force a unique approach to landing, traverse design and mission operations.

Landing Site Identification: In addition to a high potential of volatile sequestration, a landing site candidate must meet engineering and mission operations requirements: sufficient solar access to power the rover over mission lifetime, sufficient visibility to ground stations for real time communications, manageable hazards such as slopes and block abundance, etc. A landing site must have acceptable slopes within the 3-sigma landing ellipse (200-m diameter); it should also have at least 48 hours of sun and DTE communications access to accommodate checkout, rover egress, and initial operations, with margin.

At this time, four landing sites are being used to study mission design and feasibility, two in the north and two in the south. These are shown in Table 1.

Table 1. Design Reference Mission Landing Sites

Pole	Site Name	Lat.	Lon.
SP	N. Nobile	85.194S	35.436E
SP	N. Shoemaker	87.185S	59.921E
NP	Erlanger	87.19N	29.119E
NP	Hermite-A	87.436N	-49.039E

Maps Needed for Study: Layers in a landing site and traverse planning tool must include the following: *time-varying* sun and comm access; slopes (digital terrain models); water ice stability depth models; hydrogen concentration maps; permanently shadowed regions; LROC NAC photomosaics; LRO Diviner blockiness or rock abundance measure.

Traverse Design Tool: To incorporate the static and time-varying constraints on mission design, a traverse design tool has been developed that combines the

functionality of a geographic information system with mission activity planning. The RP tool relies on the ability to use the time-varying parameters of sun and comm access together with static constraints (slope limits, block hazards, etc) to determine a viable and safe traverse corridor through space and time (Fig. 1). By performing a Boolean “and” operation between relevant layers, through time, it is possible to forward-flood the landing site area to establish such corridors. A key capability in this development is “reachability analysis”: determining what areas can be attained (with margin) in a given period of time assuming selectable and realistic rover mobility capabilities and science activity durations. Rover performance and real-time decision-making on the ground will vary with the types of terrain, the level of hazard, and limits on situational awareness; these are incorporated into the tool as adjustable parameters based on testing and simulation.

The RP traverse design tool is currently being used to gauge the impact of various rover design attributes on achieving mission success at the four representative landing sites. Details will be provided.

References: [1] Colaprete, A., et al. (2010) *Science* 330.6003: 463-468. [2] Paige, D. A., et al. (2010) *Science* 330.6003: 479-482. [3] Siegler, M. A., et al. (2016) *Nature* 531.7595: 480-484.

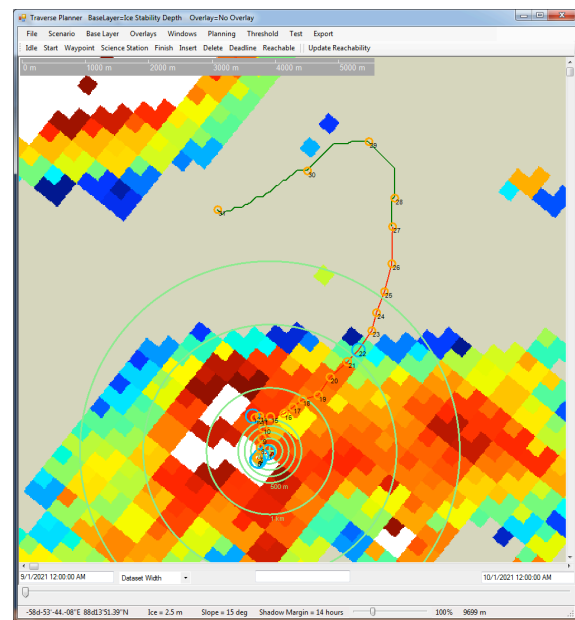


Fig. 1. Example of a traverse design for Hermit-A. The base layer is model depth to stable ice.